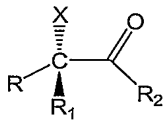
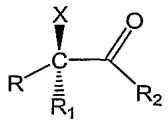
Claims

1. A process for the catalytic asymmetric synthesis of an optically active compound of the formula (1a) or (1b)

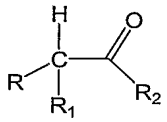


(1a)



(1b)

wherein R is an organic group; X is halogen; R_1 and R_2 which may be the same or different represents H, or an organic group or R_1 and R_2 may be bridged together forming part of a ring system; R and R_2 may be bridged together forming part of a ring system; with the provisio that R and R_1 are different and R_2 when different from H is attached through a carbon-carbon bond, comprising the step of reacting a compound of the formula (2)



(2)

with a halogenating agent in the presence of a catalytic amount of a chiral nitrogen containing organic compound.

2. The process according to claim 1 wherein R_2 is H or an optionally substituted C_{1-10} alkyl group or R and R_2 are bridged together forming part of a ring system.

3. The process according to claim 1 or 2 wherein R_1 is H or an optionally substituted C_{1-10} alkyl group.

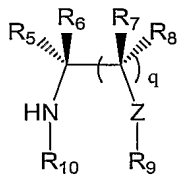
4. The process according to any of the preceding claims wherein R is an optionally substituted C_{1-10} alkyl group, an optionally substituted C_{2-8} alkylene group or a C_{1-3}-alkylaryl group.

5. The process according to claim 4 wherein R is an optionally substituted C_{1-6} alkyl group, an optionally substituted C_{2-4} alkylene group or a C_{1-2}-alkylaryl group.

6. The process according to claim 4 or 5 wherein R_1 and R_2 are H.

7. The process according to claim 1 wherein the chiral nitrogen containing organic compound is selected among compounds having a primary or secondary nitrogen atom or when appropriate in one of its salt forms.

8. The process according to claim 7 wherein the chiral nitrogen containing organic compound is selected among compounds of the formula (3)



(3)

wherein q is 0 or 1;

R_5, R_6, R_7, R_8, which may be the same or different represents H, alkyl, haloalkyl, alkoxyl, OH, amino, amide, silyl, silyl ether, COR_{11}, optionally substituted aryl, an optionally substituted heterocycle, alkyl substituted with at least one OH group, an optionally substituted amino group or optionally substituted aryl or heterocycle or R_5 and R_6 together or R_7 and R_8 together may represent a carbonyl group or when q is 1, R_5 with either R_7 or R_8 may be bridged together forming part of a ring system;

R_{11} represents an optionally substituted amino group or OR_{12} wherein R_{12} represents H, alkyl or phenyl;

R_9 and R_{10}, which may the same or different represents H, alkyl, OH, or alkoxy; or R_9 and R_{10} may be bridged together forming part of a ring system;

Z is S, O, C=O, $C(R_{14})_2$, N-R_{14} wherein R_{14} is R_5;

with the provisio that the groups R_5, R_6, R_7, R_8, R_9, R_{10}, R_{14}, and Z are selected so that the compound (3) is a chiral compound.

9. The process according to claim 8 wherein q is 1; R_5, R_6, R_7, R_8 which may the same or different represents H, COR_{11}, optionally substituted aryl or methyl substituted with at least one of the following, an OH group, an optionally substituted amino group or an optionally substituted aryl or heterocycle group; or R_5 and R_7 together represents a C_{3-5}

alkylene bridge;

R_{11} represents OH, NH_2 or NH-alkyl;

R_9 and R_{10} are H or R_9 and R_{10} together represents a methylene bridge optionally substituted with phenyl, benzyl, COOH or CO–alkoxy;

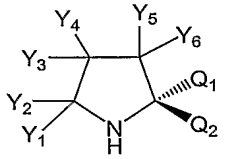
Z is CH-R_{14} or N-R_{14} wherein R_{14} represents H or alkyl.

10. The process according to claim 9 wherein either R_5 or R_6 represents H; R_7 and R_8 represents H; R_9 and R_{10} together represents a methylene bridge and Z is CH_2.

11. The process according to claim 3 wherein R_1 is H and R and R_2 each represents an optionally substituted C_{1-10} alkyl group or R_2 together with R forms an optionally substituted C_{3-5}-alkylene bridge optionally with one or more of the carbon atoms being replaced by a heteroatom.

12. The process according to claim 1 wherein one or more acids are added to the reaction media.

13. The process according to claim 8, wherein the compound of formula (3) is a compound of formula (4)



(4)

wherein Y_1, Y_2, Y_3, Y_4, Y_5, Y_6 which may be the same or different represents H, an alkyl, haloalkyl, an aryl, an alkylaryl, a heterocycle, a halogen, a hydroxyl, a carbonyl, an alkoxyl, an ester, an amine, an amide, a silyl, a silyl ether, or Y_2 and Y_3 or Y_4 and Y_5 may be bridged together forming part of a ring system one of Q_1 and Q_2 represent H, alkyl, haloalkyl, alkylaryl and the other the group $CY_7Y_8(OY_9)$ wherein Y_7 and Y_8 which may be the same or different represents alkyl, haloalkyl, an alkylaryl, a heterocycle, or optionally substituted aryl and Y_9 represents a silyl group.

14. A compound of the formula (4) as disclosed in claim 13.

15. The compound according to claim 14, wherein Y_1, Y_2, Y_3, Y_4, Y_5, Y_6 each represents H; one of Q_1 and Q_2 represents H; Y_7 and Y_8 each represents an optionally substituted aryl group, wherein the substituents are selected among alkyl and haloalkyl; Y_9 represents tri-alkyl silyl.

16. The compound according to claim 15, wherein Y_7 and Y_8 each represents 3,5-di-trifluoromethyl phenyl and Y_9 represents trimethyl silyl.

17. The compound according to claim 15, wherein Y_7 and Y_8 each represents 3,5-di-methyl phenyl and Y_9 represents trimethyl silyl.